

Deep Convection and Cirrus Anvil Flight

Objectives:

- Characterize the convective stage of the Cb (mass fluxes, updraft velocities, structure).
- Characterize the tracer distribution, aerosols (CCN, composition), temperature, and humidity in the boundary–layer inflow to convection.
- Sample the anvil microphysical properties with as much vertical and horizontal coverage as possible and through as much of the anvil lifetime as possible.
- Measure the total anvil ice mass, ice mass evolution, and gradient from source.
- Compare in situ anvil microphysical measurements with remote sensing measurements.
- Measure the radiative fluxes above and below the anvil.
- Characterize the tracer concentrations and aerosol composition in the anvil, upwind of the anvil, and downwind of the anvil through as much of its lifetime as possible.
- Measure water vapor and tracer concentrations above the anvil downwind of the convective turrets.
- Whenever possible, coordinate these flights with Aqua, Terra, or TRMM overpasses.

Strategy:

Hopefully, we will be able to forecast the locations of relatively small, isolated Cbs. Assume the forecasts give us a location (*pcon*) and time (*tcon*) where deep convection is expected to pop up.

ER-2:

- Launch 30–60 min. before *tcon* and fly to *pcon*; (may need to loiter if convection is delayed).
- Fly 100–200 km leg box off coast adjacent to *pcon* and drop 3 sondes.
- Fly box pattern above Cb–anvil system with the ground site along one of the legs parallel to the wind (see diagram).
- If anvil advects over water, launch 3 dropsondes above the anvil at different distances from the convective source region.

Proteus:

- Same as ER-2, but without the initial survey pattern.

WB57:

- Wait as long as possible launch (hopefully, the convection will have already begun).
- Fly a leg over the cloud system along the wind, extending upwind of the Cb.
- Fly a box pattern above and in the anvil and downwind of the active convection, descending 1000–3000 ft on each of the cross–wind legs outside of the anvil.
- Continue stacked box pattern down to FL450, then start back up.
- When the time on station runs out, do a spiral descent over the ground site, then fly back to Key West at low altitude.

Citation:

- Launch about the same time as the WB–57 (after convection starts).
- Fly stacked box pattern similar to WB–57, starting at cloud–base and going up to the aircraft ceiling.
- Spiral down in anvil outside convective cores.
- Repeat pattern
- Spend some time outside cloud for IN measurements.

Twin Otter:

- Launch 1.5 hours before *tcon*.
- Fly survey pattern in the vicinity of *pcon* (mostly upwind).
- Include vertical profiling from near the surface to the Twin Otter ceiling.
- If persistent anvil forms, refuel and fly box pattern directly under the ER-2.

P-3:

- Launch about 1 hour before *tcon*
- Fly legs in boundary layer parallel to tropospheric shear at least 10 km off to the side of the convection.
- A box pattern may be necessary to cover the lateral extent of the anvil
- In stratiform stage, ascend to FL100 and continue anvil measurements.

Issues:

- If we can reliably select an ideal line, we might want to just fly back and forth on the same along-wind line or racetrack pattern instead of using the box pattern.
- If the outflow anvil consists of thin layers, the stacked box pattern with uniform steps may miss them. In this case, we could use the back-seater display of ice water content or ice crystal concentration to select levels.
- We'll only be able to sample a fraction of the anvil. If the anvil is small enough, we might want to fly cross-wind patterns with the ER-2 and Proteus to map out entire anvil.
- ER-2 and Proteus should be closely coordinated in time (speed difference makes this difficult). Close temporal coordination between the ER-2 and in situ aircraft will be very difficult.
- Should we include Lagrangian spirals in the WB-57 plan?
- We should occasionally fly pairs of aircraft (ER-2/WB-57 and WB-57/Citation) along same leg closely separated in time for instrument comparison.
- We should have an alternate plan in case Cbs don't pop up as forecast. i.e., we could sample any clouds over ground site or sample tropopause region.



